

The Foundry Sands of Indiana

By

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DIVISION OF GEOLOGY

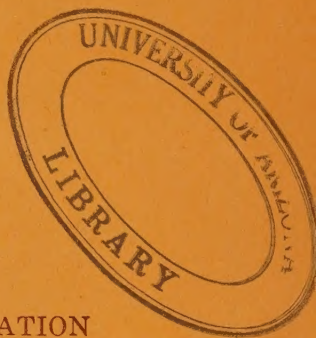
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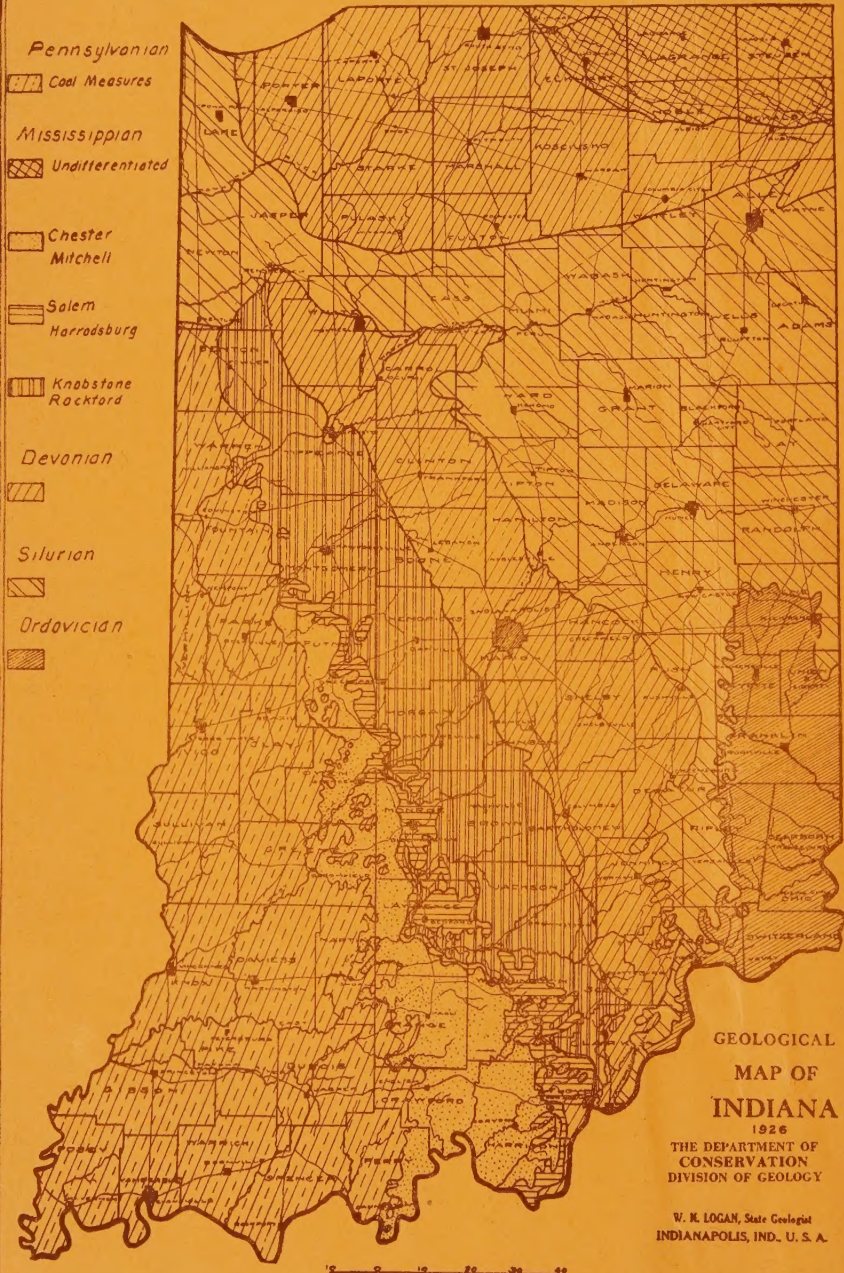
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THE FOUNDRY SANDS OF INDIANA

By W. N. LOGAN

Sands or mixtures of sand, silt and clay are used in foundries for the making of molds in which metals are cast, or in the making of cores which are used to fill the spaces intended to be voids in casting. The sands used in the making of cores are of coarse texture, that is, composed of grains of medium or large size. These grains are often bound together by an artificial binder. The sands used for molds are generally of finer texture and may contain a clay binder which holds the grains together. Molding sands of fine texture are used especially for small castings. Sands used for making molds for large castings are often of coarser texture. Molds used in the manufacture of some castings may be faced with a refractory mineral such as graphite.

Properties of Foundry Sands. The chemical and the physical properties of foundry sands must be considered in determining the value of sands for foundry use. The physical properties which are generally considered in determining the value of a sand for foundry uses includes refractoriness, cohesiveness, fineness of grain, permeability, and durability.

Refractoriness. Sands which contain substances that are easily fused at low temperatures cannot be used for the making of molds. Sands occasionally contain a number of minerals or substances which will fuse or be destroyed by the temperature of molten metal. Among these are calcium carbonate, iron compounds, carbon and hydrocarbon compounds. Such substances may permit the union of the metal with the mold or may permit the penetration of the mold by the metal.

Cohesiveness. In order that a mold may assume the proper shape and retain that shape until the metal has been poured into it the individual grains of the foundry sand must be held together by some sort of bonding material. The substance which serves this purpose to best advantage in molding sands is clay. It bonds the grains of silica together and is relatively infusible.

Fineness of Grain. The mechanical analysis or the separation of the constituent particles of a molding sand in divisions of a certain uniformity of size is an aid to the determination of the usefulness of molding sands for specific purposes. The mechanical analysis may be made by passing a given amount of the sand through a set of sieves of known mesh and by computing the amount retained on each sieve. A comparative separation may be obtained by the use of a vibrator which

will keep the particles of sand agitated in water until they settle in order of their weights. This method is more rapid and produces a separation of sand, silt and clay.

Permeability. Sands used for foundry purposes must be porous enough to permit the passage of gases through the molds. These gases may issue from the molten metal. They may be from the cushion of air on the face of the mold or they may be from the air within the pores of the mold. Gases may be created within the mold by the influence of the heat of the molten metal on moisture, hydrous minerals, or colloidal substances. The mold must be permeable enough to carry off such gases to prevent the disruption of the mold and the penetration of the metal.

Durability. Foundry sands to be used economically should possess properties which will permit them to be used again and again. Foundry sands differ greatly in durability. Some sands may be used so long as there is enough of the material remaining to complete the mold. Others are easily renewed by adding a small amount of fresh sand. Others have their usefulness destroyed by being used only a few times. Careful experimental work in the foundry is necessary to determine the length of life and the possibilities of renewal of a given sand.

Molding Sands. Foundry sands used in the manufacture of molds have different compositions and different physical properties than those sands used in the manufacture of cores. Molding sands contain a natural binder which is usually silt or clay, though other substances may contribute to at least a small degree. Good molding sands possess a proper balance between sand and bond. Too much silt or clay may fill all the space between sand grains and prevent the escape of gases. Coarse sand will require more bond than fine sand.

Core Sands. Core sands are coarser than molding sands and in addition to the small amount of natural bond which may be present they require an artificial binder. This binder must hold the sand grains together without completely filling the interstices and preventing the escape of the gases. When the core has been shaped the binder must harden sufficiently to form a coherent body which can easily be separated from the casting. Core sands should be selected to meet the requirements of the metal to be cast. The materials should be thoroughly mixed and tempered.

Mold Facing Materials. When a mold has been completed it may be faced by using pulverized minerals. Substances used include graphite, pulverized coal (sea-coal), talc, fire clay, asphalt, resin and other substances. Molasses water and kerosene are used for sponging the surfaces of some molds after they have been completed.

Blended or Synthetic Sands. Many natural deposits of sand contain the ingredients suitable for a good molding sand but unfortunately they are often mixed with undesirable materials. Such deposits are often

utilized for foundry sands by washing, drying, and screening to separate the particles into standard sizes, and then thoroughly mixing the sand, silt and clay in the proper proportion for the product desired.

Uses of Indiana Foundry Sands. The foundry sands of Indiana are used in the making of molds and in the making of cores. The molding sands may be used in the making of molds for the casting of aluminum, brass, malleable iron, stove plate, medium gray iron, heavy gray iron, furnace castings, typewriter castings, light hardware, auto castings, heavy car castings, radiator castings and heavy machinery castings.

Geological Distribution. Many formations in Indiana produce sands which are suitable for foundry purposes when the rocks of these formations are disintegrated under the influence of weathering. These residual materials are in some localities naturally blended by the sorting action of running water but as a rule preparatory methods must be used before they can be utilized. The larger part of the sands of the residual type belong to the post-Pleistocene epoch of geological time though some of them are doubtless of Pleistocene and pre-Pleistocene age.

Geographical Distribution. Foundry sands are widely distributed in Indiana. There are few, if any, counties in the state which do not contain some materials that are suitable for foundry purposes. In many of the counties are natural deposits which may be used for foundry sands as they are taken from the pits. The counties in which commercial quantities of foundry sands have been found include: Allen, Bartholomew, Cass, Clark, Clay, Elkhart, Gibson, Grant, Harrison, Henry, Jackson, Jefferson, Knox, Lagrange, Lake, Laporte, Marion, Morgan, Monroe, Newton, Owen, Porter, Starke, St. Joseph, Spencer, Steuben, Sullivan, Tippecanoe, Vanderburg, Vermillion, and Vigo.

The localities near which foundry sands have been produced in Indiana include: Fort Wayne and New Haven in Allen County; Columbus in Bartholomew County; Lake Cicott in Cass County; New Albany in Floyd County; Brazil in Clay County; Goshen in Elkhart County; Marion in Grant County; Newcastle in Henry County; Brownstown and Seymour in Jackson County; Madison in Jefferson County; Vincennes in Knox County; Wolcottville in Lagrange County; East Gary and Hammond in Lake County; Michigan City in Laporte County; Indianapolis in Marion County; Bloomington in Monroe County; Centerton, Landersdale, and Paragon in Morgan County; Gosport and Spencer in Owen County; Valparaiso in Porter County; Mishawaka and South Bend in St. Joseph County; Richland Junction, Rockport, and Grand View in Spencer County; North Judson in Starke County; Pleasant Lake in Steuben County; Merom in Sullivan County; Lafayette in Tippecanoe County; Evansville in Vanderburg County; Hillsdale in Vermillion County; and Terre Haute in Vigo County.

Analyses of Indiana Foundry Sands.

A large number of samples of Indiana foundry sands have been tested in foundries and in laboratories. The Division of Geology has been conducting investigations of Indiana foundry sands in the field and laboratory for a number of years. During the field work samples of foundry sands are collected. These samples are being analyzed in the laboratory as time from other duties permits. When the work is completed a report will be published. A brief report on the foundry sands of Indiana was published in the "Handbook of Indiana Geology" in 1922, a publication of the Division of Geology of the Indiana Conservation Department.

In a book entitled "Foundry Sand, Its Uses and Abuses", published by Eugene W. Smith, General Foundry Superintendent, Crane Company, Chicago, some Indiana foundry sands are discussed as follows:

"Indiana has a plentiful supply of good molding sands of every known grade and suited to all grades of castings, from the lightest of hardware to the heaviest machinery castings.....

"Dyeton Sand (Whitewater and Ohio Valleys) Vibratory test: Bond, 47.36%; Silica, 52.64%. Color, dark yellow.....useful for light carriage work, auto trimmings, typewriter castings, name plates, and such work as requires japanning or plating."

Spencer County. "Luce Township, No. 1. Bond, 24.24%; Silica, 75.75%. Color, light brown.....open fine sand, very uniform in grain, should prove an excellent sand for brass and aluminum.

".....Sandale A-1. Bond, 29%; Silica, 71%.....one of the few fine sands, having no excess of bond.....should prove an excellent sand for light novelty work.....wear well and give excellent results where plating is required.

".....Sandale A-1. Open. Bond, 25%; Silica, 75%.....carries all of the characteristics of the A-1 Sandale but has a slight advantage in that it carries a slightly less bond.

".....Sandale Special 00. Bond, 30%; Silica, 70%.....a strong bond, fine sand, suitable for stove plate and light hardware.....good sand for brass work, but for aluminum a more open sand combination would be required.....

".....Diamond H Sandale. A strong bond, fine sand of about the same texture as the Special 000 but a little more open.....suitable for stove plate, malleable, brass, and light hardware requiring plating, enameling, etc.

".....Sandale No. A-B. Bond, 25%; Silica, 75%.....a medium fine sand, suitable for light bench work, machine molding or brass.....compares favorably with best of Indiana or Kentucky fine sands.....

".....Luce Township No. 5. Bond, 30.90%; Silica, 69.09%. Color, dark brown. This is a strong, open, medium grain sand, having a composite fine of 29%.....an excellent sand for heavy bench or floor molding.....

".....Luce Township No. 1½. Bond, 44.73%; Silica, 55.26%. Color bond, yellow; silica, dark yellow.....extremely fine sand, suitable for brass and non-ferrous metals only....."

Perry County. "Troy T-5. Bond, 33%; Silica, 67%. Bond, dark yellow; silica, brown.....a medium heavy grain, strong, open sand, and should prove suitable for general casting, bench, floor and machine molding."

LaPorte County. "Wanetah sand. Bond, 24%; Silica, 76%. This is an extremely open sand of very even texture and medium grain.....one of the most useful sands in the country, particularly in the surrounding States, where the average molding sands are too high in bond..... Valuable as an opener for facing sands and may be used on any class of work from one pound castings up to 500 pounds.....too fine in grain for heavier castings than 500 lbs."

Floyd County. "Local sand, specimen not graded. Color, dark. Bond, 24.48%; Silica, 75.51%. This is a heavy, open grained, strong sand, suitable for heavy machinery and the rougher forms of floor work....."

Morgan County. "Centerton Bradford sand. Bond, 30.76%; Silica, 69.23%. Color, light brown. This is a splendid grade of medium heavy grain, open and strong sand. It is suitable for heavy bench molding, also floor work, general machinery and car work, when used alone. It is a little too coarse for light castings where a finish is required. It is an excellent opener for prepared facings for use on castings up to eight or nine hundred pounds. The wearing qualities are excellent and it should work well in combination with Illinois or Wisconsin sands. It will stand very hard ramming or pressures."

St. Joseph County. "Mishawaka River Grove sand (Core). Bond, 22.50%; Silica, 77.50%. This sand is of the same texture and grain as the Custer Park sand. It makes a good core-sand but care must be taken with the binder used or cores will become too close. It is not advisable to use this as a molding sand inasmuch as it weakens so easily on account of fineness of grain."

Porter County. "Custer Park sand. Bond, 14.28%; Silica, 85.71%. This is a fine, open grained sand, usually used as a core-sand, where unusually fine finish is desired, but on account of its excess fineness it would not be safe to use for anything heavy. This sand must be handled with care as it will weaken easily. It makes a splendid core-sand, but cores vented and binder not used too strong. It is usually used for stand-up cores."

Cass County. "Lake Cicotte. Bond, 7.40%; Silica, 92.50%. This is a wonderfully even grained fine sand, suitable for light cores made in driers or one-half cores on plate. The bond is not sufficient for stand-up cores and for the same reason it is not suitable for a molding sand, unless blended with a stronger grade of fine sand, where an opener is needed. It has a composite fine of 70%."

Gibson County. "Patoka No. 1. Bond, 27.58%; Silica, 72.41%. This is an even grained extremely open strong bond sand, suitable for radiator castings and all classes of work which require hard ramming or pressures, or deep pocket work. It is useful as an opener for the medium class of castings....is of the same character as the Wanetah or Canadian sands.

".....Patoka No. 2. Bond, 18.36%; Silica, 81.63%.....same general texture as No. 1 Patoka, excepting that it has less bond and is suitable for the same general class of work. It is an even grained, medium strong and open sand.

".....Patoka No. 3. Bond, 17%; Silica, 82%.....same characteristics as the No. 1 and No. 2 Patoka but is much finer in grain..... an open strong sand.

".....Patoka No. 5. Bond, 68.42%; Silica, 31.57%.....an extremely fine sand and while it also is a strong sand it is not advisable to use on any form of castiron work.....

".....Patoka No. 6. Bond, 23.66%; Silica, 73.33%.....an open, strong, medium heavy grained sand, useful for medium castings, bench, machine and floor molding. This sand has a very even texture and should provide a good finish to general castings. If excessive core work is used a good binder should be at hand."

The accompanying analyses of Indiana foundry sands were made by the American Foundry Association, the results being obtained through Mr. P. Willard Crane.

RESULTS OF TESTS ON INDIANA MOLDING SANDS

Laboratory Number	Grade if Used		Screen Analysis											Water Per cent	Bond Strength	Permeability	
			On 6	On 12	On 20	On 40	On 70	On 100	On 140	On 200	On 270	Through 270	Clay				Total
81	Clark Co. Jeffersonville	Pro-duced				.06	.12	.18	.57	1.97	4.96	84.30	7.84	100.00	4.4 5.9 7.1 8.0	134 143 156 159	5.06 5.76 5.65 5.50
6-A	Gibson Co. Patoka	Pro-duced			4	10.6	30.0	20.4	8.8	2.4	1.3	19.6	6.5	100.00	5.2 7.0 8.8	264 302 214	84.0 113.0 76.0
23	Perry Co. Troy	Pro-duced				2.3	22.0	13.8	5.2	2.3	1.0	38.6	14.8	100.00	5.9 7.1 8.0 9.5	230 250 254 268	5.1 5.5 14.0 13.9
24	Perry Co. Troy	Pro-duced				.1	.2	.2	.2	.3	.4	72.4	26.2	100.00	5.9 7.2 7.7 9.1	277 307 290 274	2.6 5.7 2.8 2.4
25	Perry Co. Troy	Pro-duced				5.6	36.1	11.8	3.5	1.2	.7	22.0	19.1	100.00	6.7 7.1 8.0 9.2	250 319 255 250	12.8 23.0 52.0 37.8
26	Perry Co. Troy	Pro-duced				4.5	43.2	23.6	6.2	2.1	.7	5.3	14.4	100.00	5.3 6.0 7.1 9.8	327 342 366 305	303.0 116.0 117.0 125.0
7-A	Spencer Co. Rockport	Pro-duced					.4	.4	.6	.6	2.4	82.8	12.8	100.00	3.9 5.8 7.9 9.5	213 309 243 238	3.62 5.85 3.51 3.44
5-A	Spencer Co. Rockport	Pro-duced					3.0	7.4	11.0	4.2	3.7	65.1	5.6	100.00	4.0 5.7 6.6 7.7 10.2	135 152 159 173 176	3.58 4.16 4.85 5.22 4.18
8-A	Spencer Co. Rockport	Pro-duced				.2	3.2	8.6	11.4	4.4	3.0	62.4	6.8	100.00	4.0 5.1 7.6 9.5	170 190 197 209	3.9 4.7 6.8 10.0
4-A	Spencer Co. Rockport	Pro-duced					1.8	4.4	6.0	2.6	6.4	71.6	7.2	100.00	3.9 6.6 8.1	169 238 273	3.48 7.12 6.25
3-A	Spencer Co. Rockport	Pro-duced					.4	1.0	3.0	2.2	5.4	79.2	8.8	100.00	4.4 6.1 8.4	173 228 227	4.25 7.14 3.52
2-A	Spencer Co. Rockport	Pro-duced						.2	.2	5.0	3.0	72.0	19.6	100.00	4.3 7.0 8.6 10.4	193 197 270 244	1.33 1.67 2.08 1.60

Molding Sand Production

Indiana ranked second in quantity production of molding sand in 1926. The value of the molding sand produced in the State during that year was \$356,921. In 1924 and in 1925 it held fourth rank in quantity production, producing more than 400,000 tons. In 1928, the sales of molding sand by producers in Indiana totaled 361,740 tons, valued at \$202,052.

Molding Sand Producers in Indiana

Allen County, New Haven, Bates Gravel Company.
 Allen County, Ft. Wayne, B. and B. Sand and Gravel Company.
 Allen County, Ft. Wayne, Spy Run Sand and Gravel Company.
 Allen County, Ft. Wayne, Stuck Sand and Gravel Company.
 Clark County, Jeffersonville, W. T. Ingram.
 Clark County, New Albany, Newport Sand Bank Company.
 Clark County, Jeffersonville, John Sames.
 Clark County, Jeffersonville, John W. Taylor.
 Gibson County, Patoka, Houghland and Hardy. Office at Evansville.
 Jackson County, Brownstown, Phillip Grosman.
 La Porte County, Michigan City, Pinkston Coonrad.
 La Porte County, Wanetah, Wanetah Molding Sand Company.
 Morgan County, Centerton, Bradford Sand Company.
 Porter County, McCool, J. S. Robbins.
 Perry County, Troy, Houghland and Hardy.
 Spencer County, Rockport, Walker Sand Company.
 Spencer County, Rockport, Rockport Molding Sand Company.
 Spencer County, Tell City, Houghland and Hardy.
 Spencer County, Rockport, Houghland and Hardy.
 Starke County, North Judson, C. W. Weninger.
 St. Joseph County, South Bend, Chas. Smith.
 St. Joseph County, South Bend, Chas. Whiteman.
 St. Joseph County, South Bend, F. S. Ritter.
 Vigo County, Terre Haute, Houghland and Hardy.

AVAILABLE GEOLOGICAL REPORTS

The reports and maps listed below may be obtained from the office of the State Geologist, Room 135, State Capitol.

Separate volumes including reports of the State Geologist were published until 1916. The following are available:

7th (1875)	\$2.00	24th (1899)	\$2.00
15th (1885-6)	.50	25th (1900)	2.00
16th (1888)	.50	26th & 27th (1901-2)	3.00
17th (1891)	.50	30th (1905)	3.00
19th (1894)	.50	39th (1914)	1.50
21st (1896)	2.50	40th (1915)	.50
23rd (1898)	10.00	41st (1916)	free

Recent annual reports of the State Geologist, including miscellaneous papers, have been published in the following available reports of the Conservation Department, which are free:

- 3rd (1921) Gold in Indiana; The New Providence Shale; The St. Louis ls.
- 4th (1922) The New Albany Shale; Peat Deposits of Indiana.
- 5th (1923) Petroleum Conservation.
- 6th (1924) Laws Affecting Oil and Gas Operations in Indiana.
- 7th (1925) Coal Losses of Indiana.
- 8th (1926) Report on Indiana Caves, including Marengo.
- 9th (1927) Subterranean Drainage Phenomena.
- 10th (1928) Geological Conditions in the Siosi Oil Field.
- 11th (1929) The Mineral Fuel Resources of Indiana.

The following special reports have been published separately:

- Kaolin in Indiana (1919)—\$0.25.
- Handbook of Indiana Geology (1922)—\$3.00 in Indiana; \$5.00 to non-residents. Includes geography, physiography, hydrology, stratigraphy, paleontology, economic geology and oil shales of Indiana.
- Petroleum Industry in Indiana in 1923—free.
- Geological Conditions in the Oil Fields of Southwestern Indiana (1924)—\$0.50 in Indiana; \$0.75 to non-residents.
- Laws and Regulations Affecting Oil and Gas Operations in Indiana (1924)—free.
- Geology of the Deep Wells of Indiana (1926)—\$1.00.
- Regulations concerning plugging of abandoned gas and oil wells and filing of deep wells records, with blank well log forms—free.
- Geology of the Silurian Rocks of Northern Indiana (1928)—\$1.00.
- Indiana Oolitic Limestone Map of Lawrence County (1928)—\$1.00 on bond stock, \$2.00 on enamel stock.
- Indiana Oolitic Limestone Map of Monroe-Owen Counties (1928)—\$1.00 on bond stock, \$2.00 on enamel stock.
- The Geological History of the Vertebrates of Indiana (1929)—Cloth bound, \$1.25; Paper bound, \$1.00.
- The Ceramic Materials of Indiana (1929)—free.
- U. S. Geological Survey topographic sheets of portions of Indiana are sold through this office for 10c each.